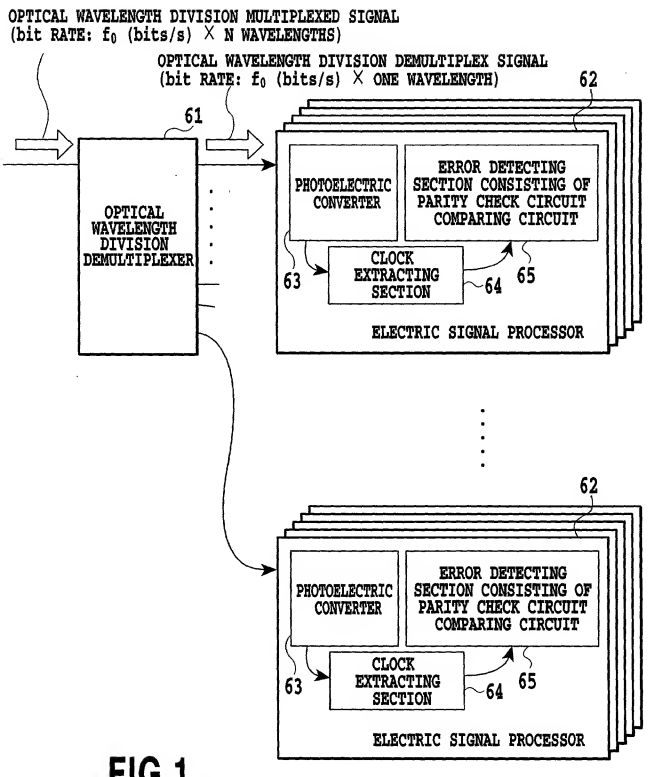


FIG.1
PRIOR ART

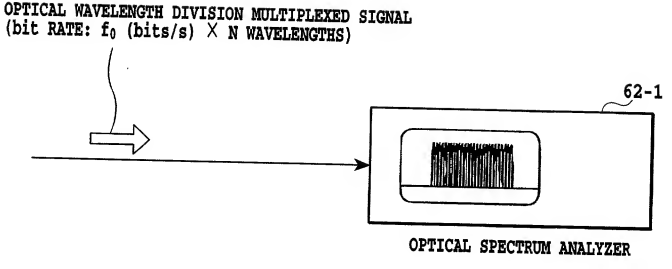


FIG.2
PRIOR ART

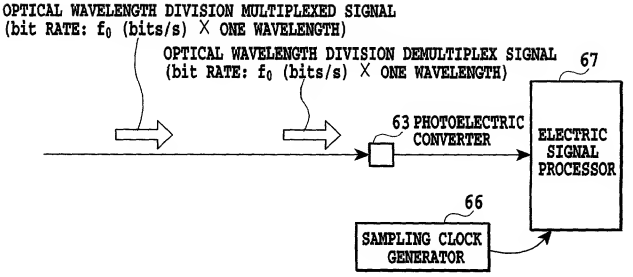


FIG.3
PRIOR ART

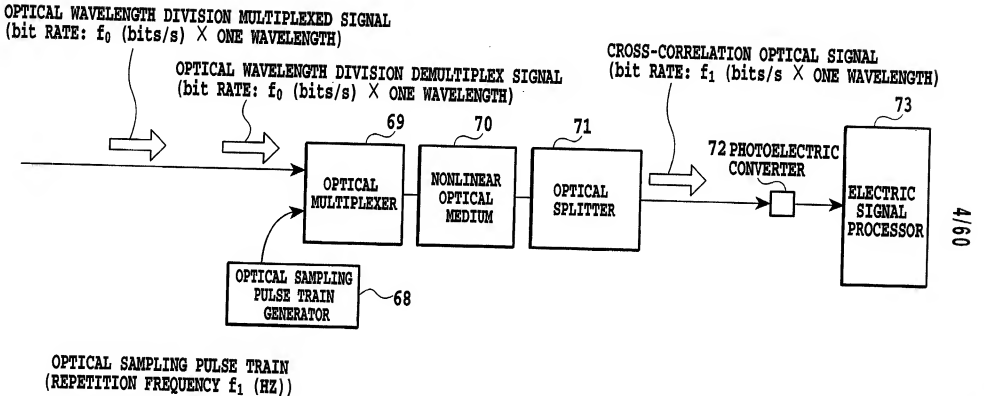


FIG.4
PRIOR ART

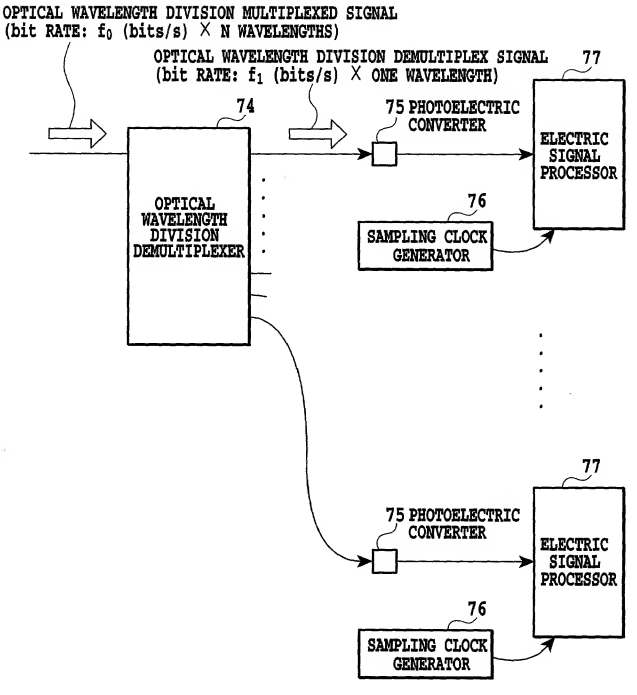


FIG.5
PRIOR ART

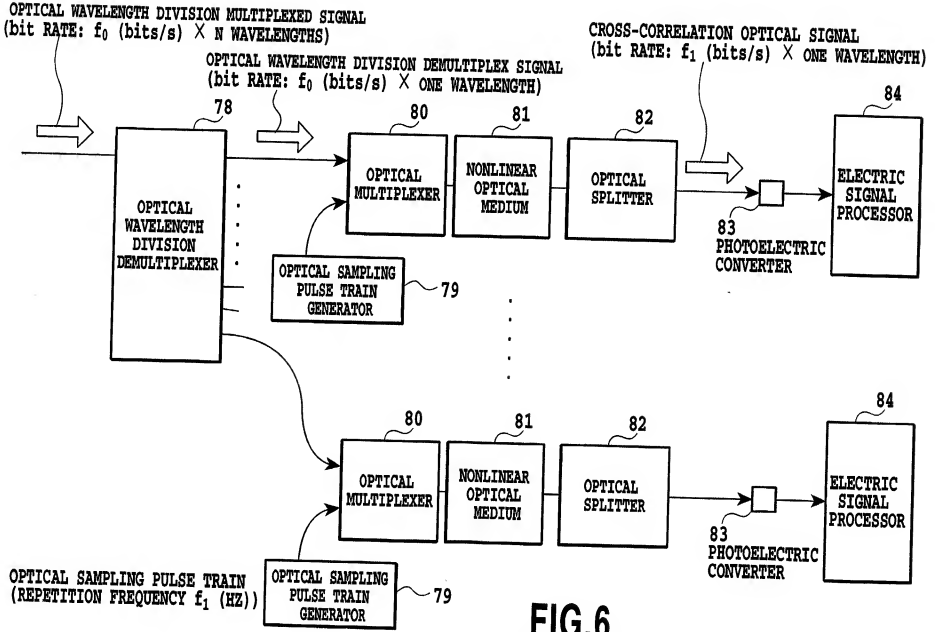


FIG.6
PRIOR ART

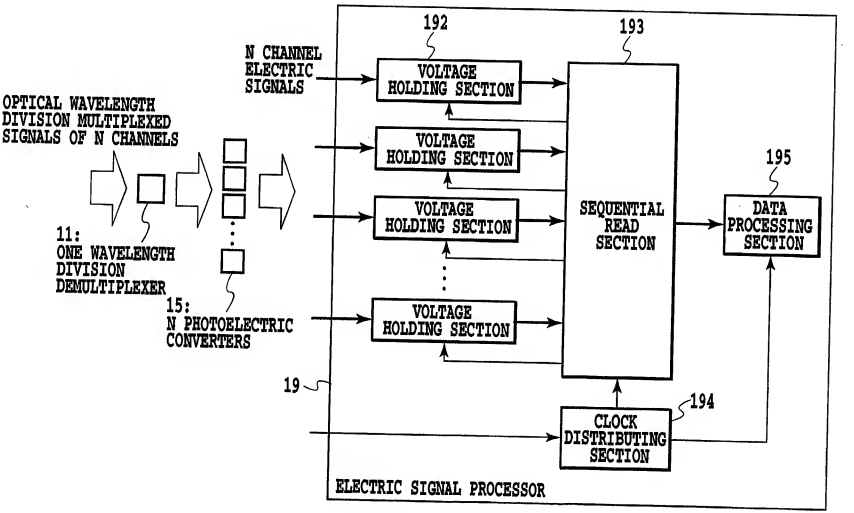

192
193
N CHANNEL ELECTRIC SIGNALS
VOLTAGE HOLDING SECTION
VOLTAGE HOLDING SECTION
VOLTAGE HOLDING SECTION
VOLTAGE HOLDING SECTION
OPTICAL WAVELENGTH DIVISION MULTIPLEXED SIGNALS OF N CHANNELS
11: ONE WAVELENGTH DIVISION DEMULTIPLEXER
15: N PHOTOELECTRIC CONVERTERS
SEQUENTIAL READ SECTION
195
DATA PROCESSING SECTION
19
194
CLOCK DISTRIBUTING SECTION
ELECTRIC SIGNAL PROCESSOR

FIG.7

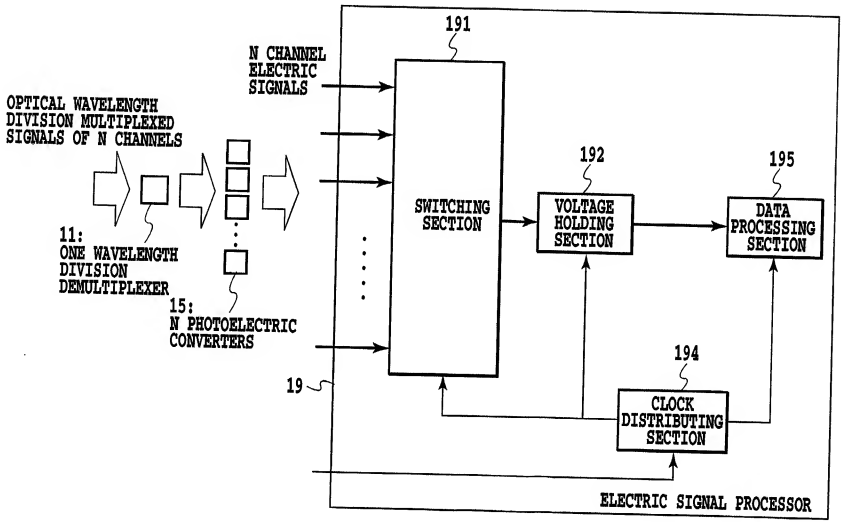

191
N CHANNEL ELECTRIC SIGNALS
OPTICAL WAVELENGTH DIVISION MULTIPLEXED SIGNALS OF N CHANNELS
11: ONE WAVELENGTH DIVISION DEMULTIPLEXER
15: N PHOTOELECTRIC CONVERTERS
SWITCHING SECTION
192
VOLTAGE HOLDING SECTION
195
DATA PROCESSING SECTION
194
CLOCK DISTRIBUTING SECTION
19
ELECTRIC SIGNAL PROCESSOR

FIG.8

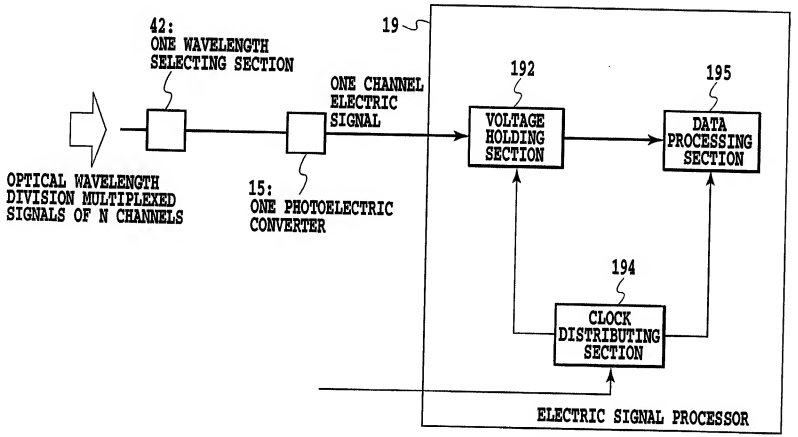


FIG.9

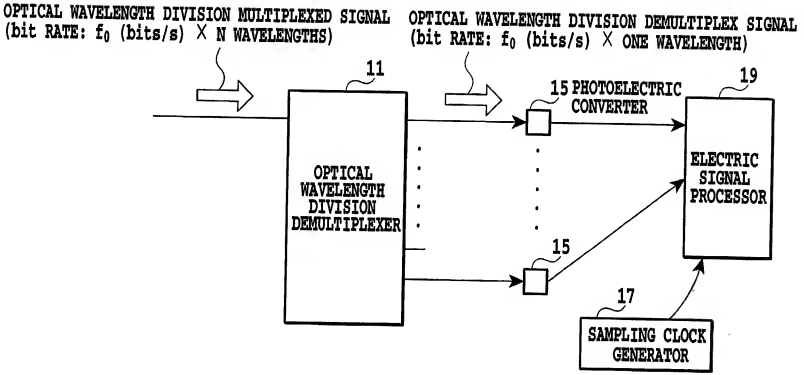


FIG.10

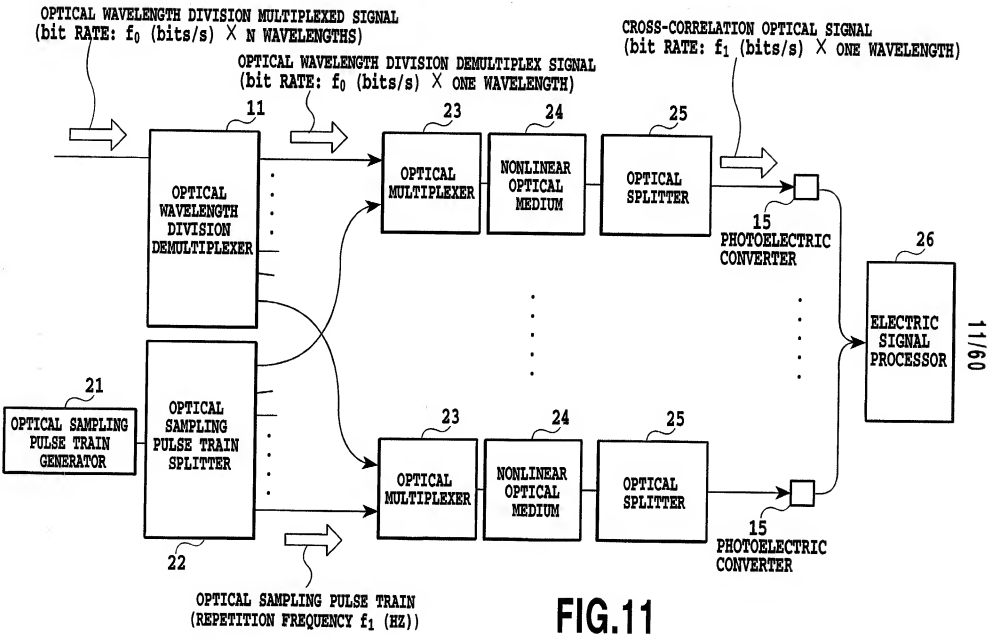


FIG.11

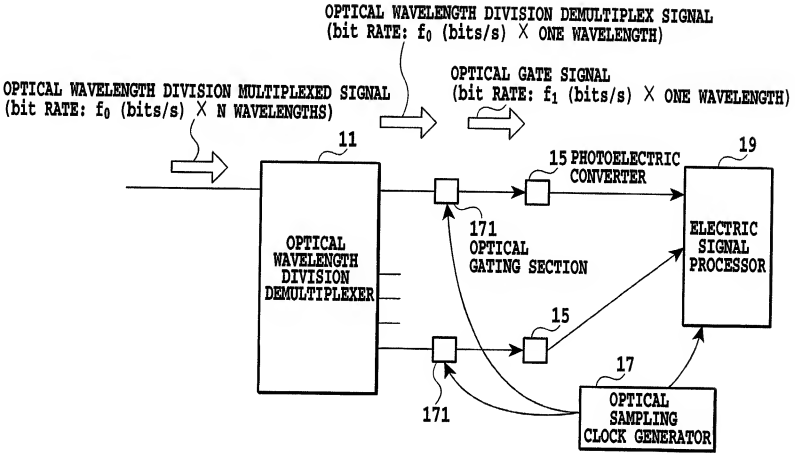


FIG.12

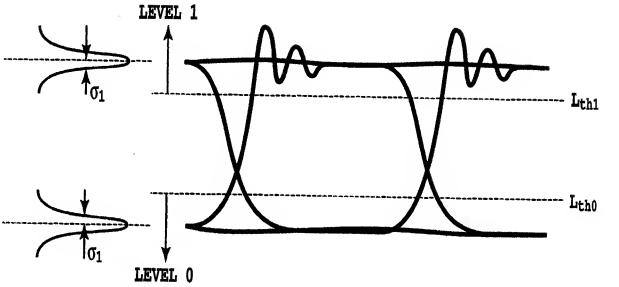


FIG.13

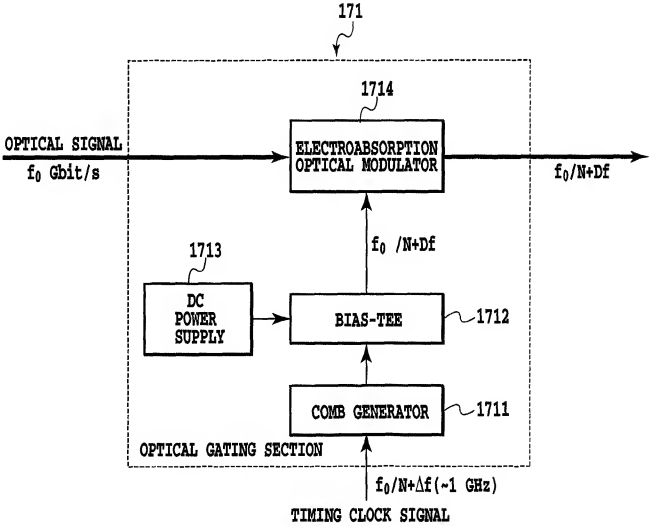


FIG.14

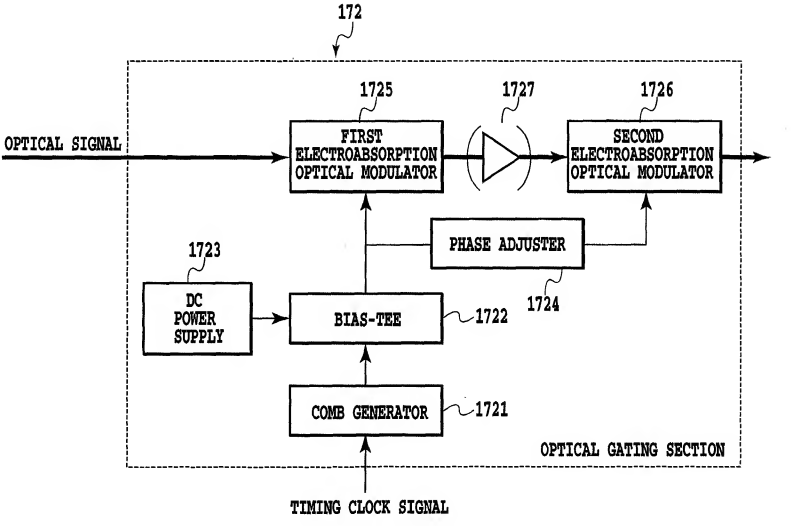


FIG.15

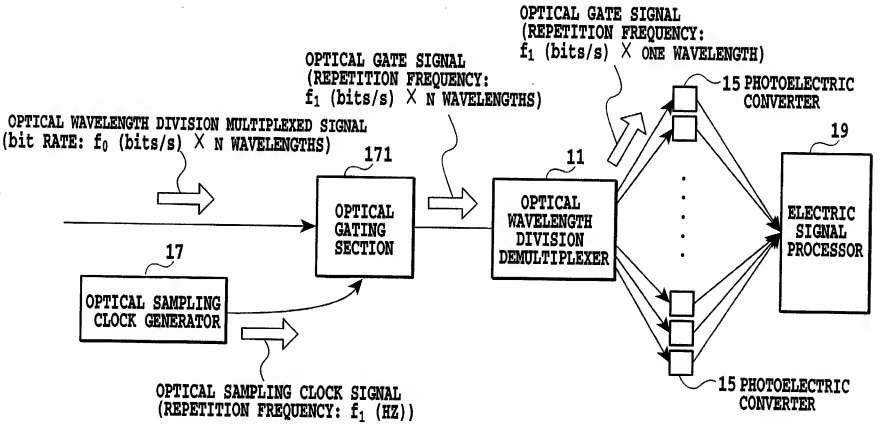


FIG.16

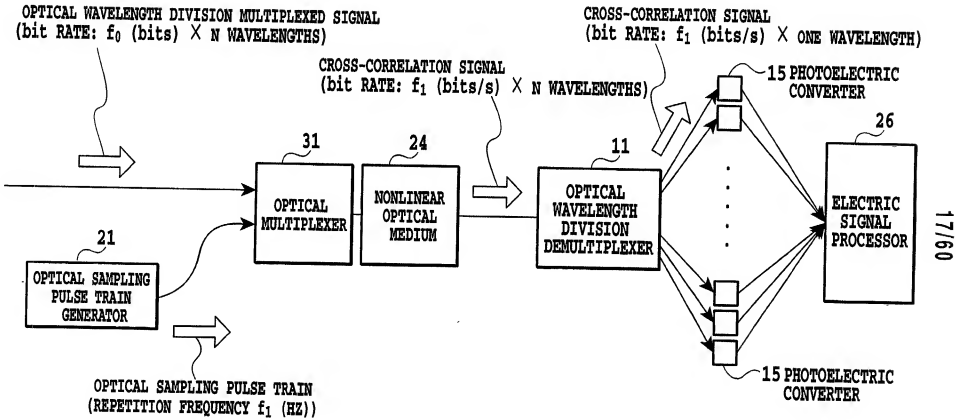


FIG.17

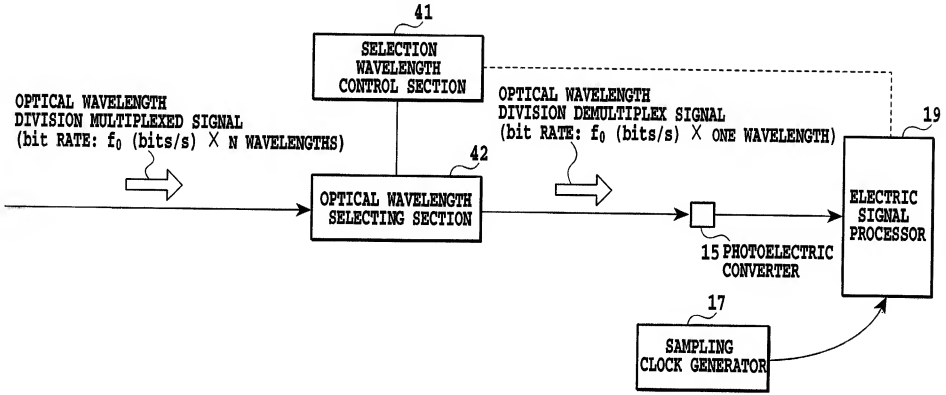


FIG.18

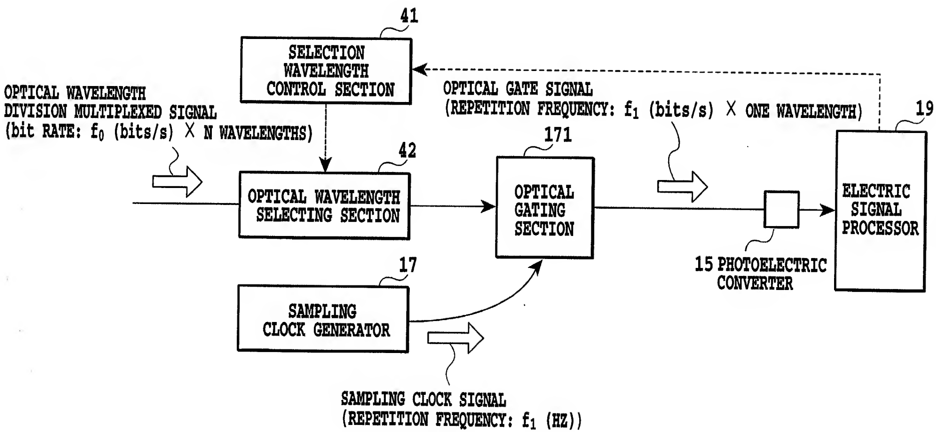

41
SELECTION WAVELENGTH CONTROL SECTION
OPTICAL WAVELENGTH DIVISION MULTIPLEXED SIGNAL
(bit RATE: f_0 (bits/s) × N WAVELENGTHS)
42
OPTICAL WAVELENGTH SELECTING SECTION
17
SAMPLING CLOCK GENERATOR
SAMPLING CLOCK SIGNAL
(REPETITION FREQUENCY: f_1 (HZ))
171
OPTICAL GATING SECTION
OPTICAL GATE SIGNAL
(REPETITION FREQUENCY: f_1 (bits/s) × ONE WAVELENGTH)
15 PHOTOELECTRIC CONVERTER
19
ELECTRIC SIGNAL PROCESSOR

FIG.19

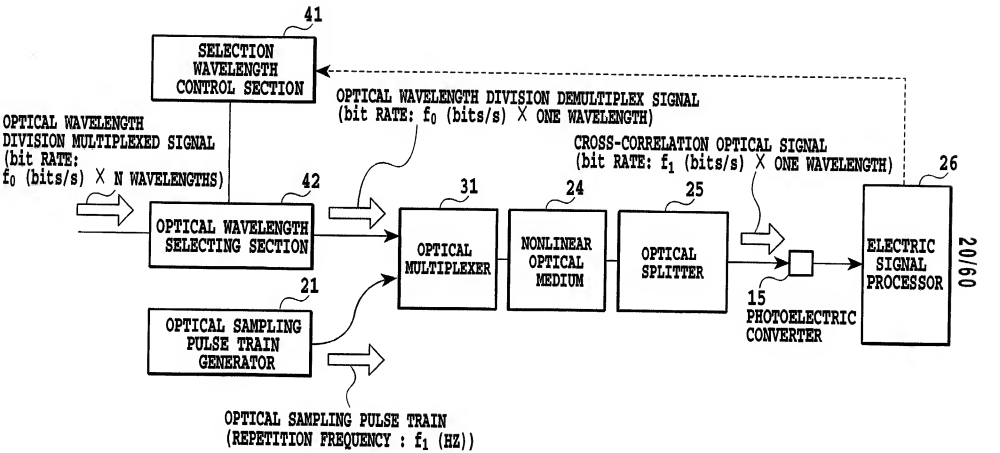

41
SELECTION WAVELENGTH CONTROL SECTION
OPTICAL WAVELENGTH DIVISION MULTIPLEXED SIGNAL (bit RATE: f_0 (bits/s) X N WAVELENGTHS)
OPTICAL WAVELENGTH DIVISION DEMULTIPLEX SIGNAL (bit RATE: f_0 (bits/s) X ONE WAVELENGTH)
CROSS-CORRELATION OPTICAL SIGNAL (bit RATE: f_1 (bits/s) X ONE WAVELENGTH)
26
42
31
24
25
OPTICAL WAVELENGTH SELECTING SECTION
OPTICAL MULTIPLEXER
NONLINEAR OPTICAL MEDIUM
OPTICAL SPLITTER
ELECTRIC SIGNAL PROCESSOR
15
PHOTOELECTRIC CONVERTER
21
OPTICAL SAMPLING PULSE TRAIN GENERATOR
OPTICAL SAMPLING PULSE TRAIN (REPETITION FREQUENCY : f_1 (HZ))

FIG.20

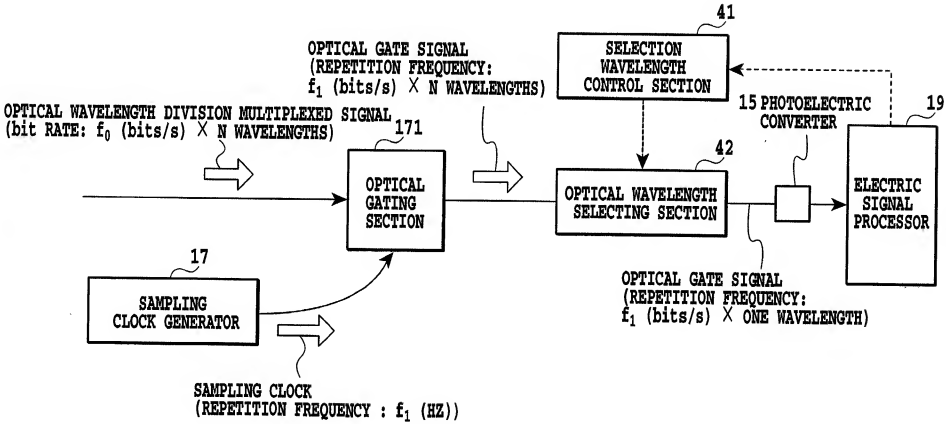


FIG.21

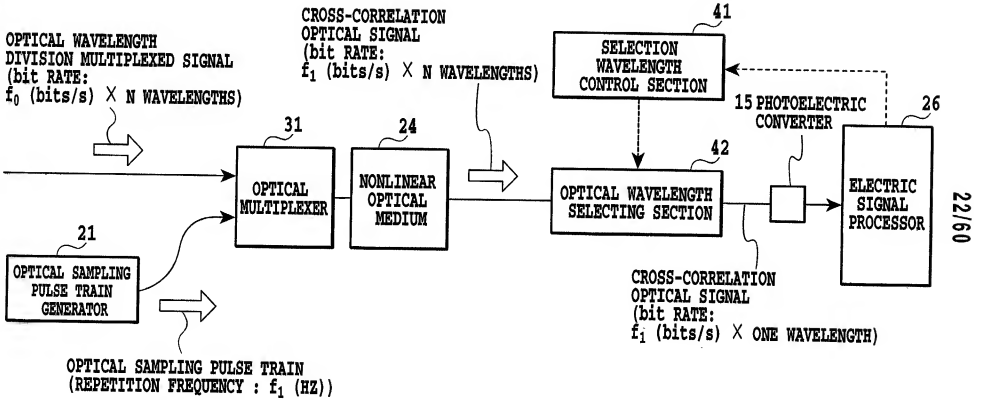

OPTICAL WAVELENGTH DIVISION MULTIPLEXED SIGNAL (bit RATE: f_0 (bits/s) X N WAVELENGTHS)
CROSS-CORRELATION OPTICAL SIGNAL (bit RATE: f_1 (bits/s) X N WAVELENGTHS)
41
SELECTION WAVELENGTH CONTROL SECTION
15 PHOTOELECTRIC CONVERTER
26
31
24
42
OPTICAL MULTIPLEXER
NONLINEAR OPTICAL MEDIUM
OPTICAL WAVELENGTH SELECTING SECTION
ELECTRIC SIGNAL PROCESSOR
21
OPTICAL SAMPLING PULSE TRAIN GENERATOR
CROSS-CORRELATION OPTICAL SIGNAL (bit RATE: f_1 (bits/s) X ONE WAVELENGTH)
OPTICAL SAMPLING PULSE TRAIN (REPETITION FREQUENCY : f_1 (HZ))

FIG.22

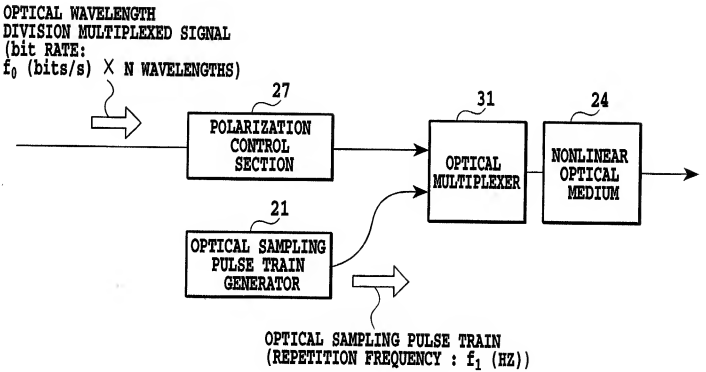

OPTICAL WAVELENGTH
DIVISION MULTIPLEXED SIGNAL
(bit RATE:
f_0 (bits/s) X N WAVELENGTHS)
27
POLARIZATION CONTROL SECTION
31
OPTICAL MULTIPLEXER
24
NONLINEAR OPTICAL MEDIUM
21
OPTICAL SAMPLING PULSE TRAIN GENERATOR
OPTICAL SAMPLING PULSE TRAIN
(REPETITION FREQUENCY : f_1 (HZ))

FIG.23

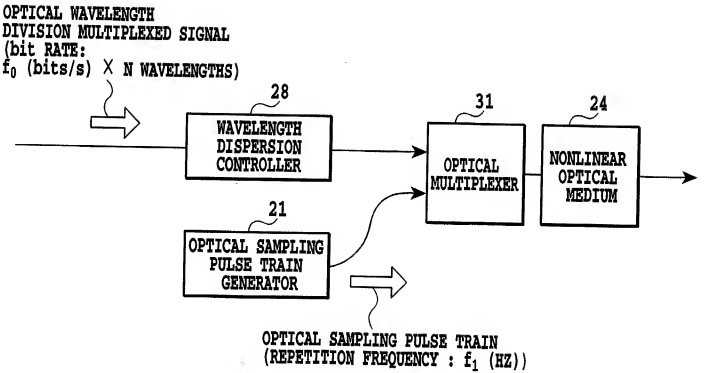

OPTICAL WAVELENGTH
DIVISION MULTIPLEXED SIGNAL
(bit RATE:
f_0 (bits/s) X N WAVELENGTHS)
28
WAVELENGTH
DISPERSION
CONTROLLER
31
OPTICAL
MULTIPLEXER
24
NONLINEAR
OPTICAL
MEDIUM
21
OPTICAL SAMPLING
PULSE TRAIN
GENERATOR
OPTICAL SAMPLING PULSE TRAIN
(REPETITION FREQUENCY : f_1 (HZ))

FIG.24

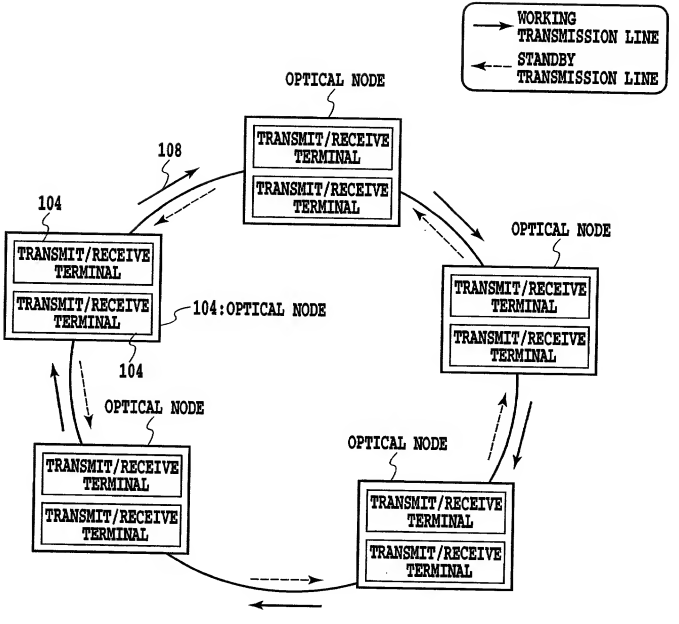


FIG.25A

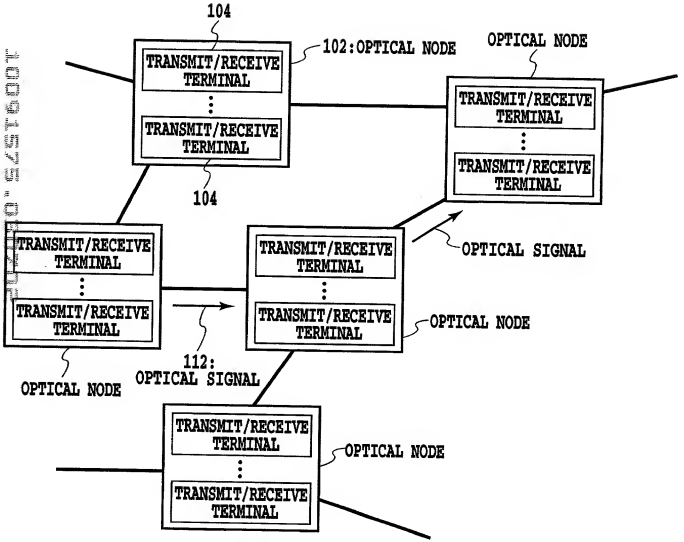

104
102:OPTICAL NODE
OPTICAL NODE
TRANSMIT/RECEIVE TERMINAL
TRANSMIT/RECEIVE TERMINAL
104
OPTICAL SIGNAL
OPTICAL NODE
112:
OPTICAL SIGNAL
OPTICAL NODE
OPTICAL NODE

FIG.25B

FIG.26

FIG.26A	FIG.26B

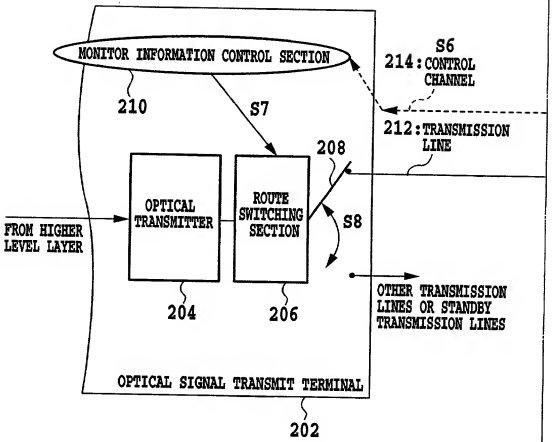


FIG.26A

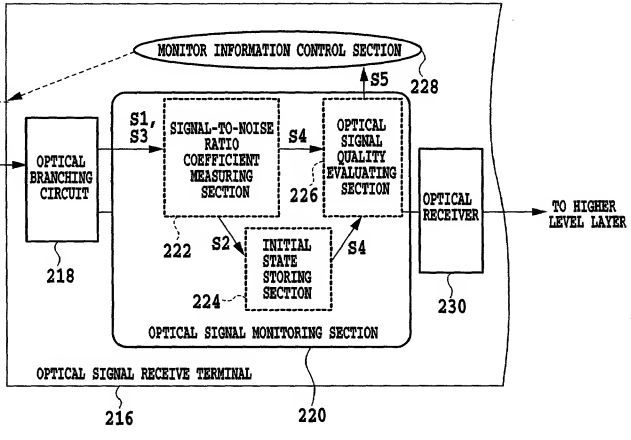

MONITOR INFORMATION CONTROL SECTION
228
S5
S1,
S3
SIGNAL-TO-NOISE RATIO COEFFICIENT MEASURING SECTION
S4
OPTICAL SIGNAL QUALITY EVALUATING SECTION
226
OPTICAL BRANCHING CIRCUIT
218
222
S2
INITIAL STATE STORING SECTION
S4
224
OPTICAL RECEIVER
TO HIGHER LEVEL LAYER
230
OPTICAL SIGNAL MONITORING SECTION
OPTICAL SIGNAL RECEIVE TERMINAL
216
220

FIG.26B

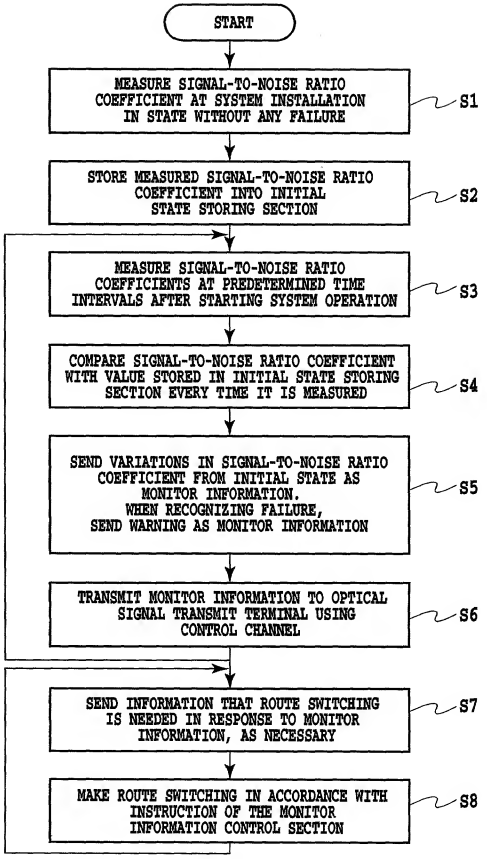

START
MEASURE SIGNAL-TO-NOISE RATIO COEFFICIENT AT SYSTEM INSTALLATION IN STATE WITHOUT ANY FAILURE
S1
STORE MEASURED SIGNAL-TO-NOISE RATIO COEFFICIENT INTO INITIAL STATE STORING SECTION
S2
MEASURE SIGNAL-TO-NOISE RATIO COEFFICIENTS AT PREDETERMINED TIME INTERVALS AFTER STARTING SYSTEM OPERATION
S3
COMPARE SIGNAL-TO-NOISE RATIO COEFFICIENT WITH VALUE STORED IN INITIAL STATE STORING SECTION EVERY TIME IT IS MEASURED
S4
SEND VARIATIONS IN SIGNAL-TO-NOISE RATIO COEFFICIENT FROM INITIAL STATE AS MONITOR INFORMATION. WHEN RECOGNIZING FAILURE, SEND WARNING AS MONITOR INFORMATION
S5
TRANSMIT MONITOR INFORMATION TO OPTICAL SIGNAL TRANSMIT TERMINAL USING CONTROL CHANNEL
S6
SEND INFORMATION THAT ROUTE SWITCHING IS NEEDED IN RESPONSE TO MONITOR INFORMATION, AS NECESSARY
S7
MAKE ROUTE SWITCHING IN ACCORDANCE WITH INSTRUCTION OF THE MONITOR INFORMATION CONTROL SECTION
S8

FIG.27

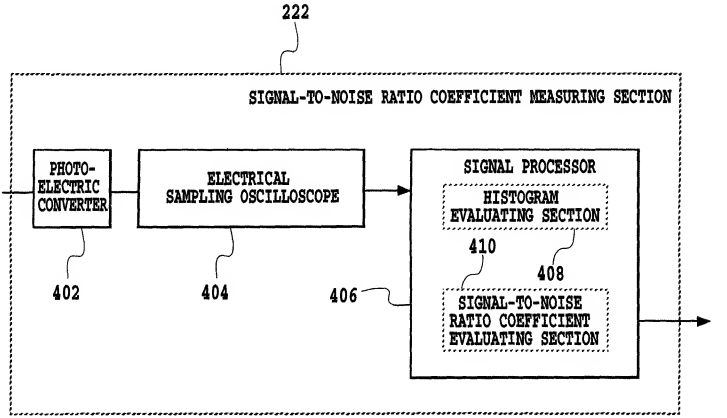

222
SIGNAL-TO-NOISE RATIO COEFFICIENT MEASURING SECTION
PHOTO-ELECTRIC CONVERTER
ELECTRICAL SAMPLING OSCILLOSCOPE
SIGNAL PROCESSOR
HISTOGRAM EVALUATING SECTION
410
408
402
404
406
SIGNAL-TO-NOISE RATIO COEFFICIENT EVALUATING SECTION

FIG.28

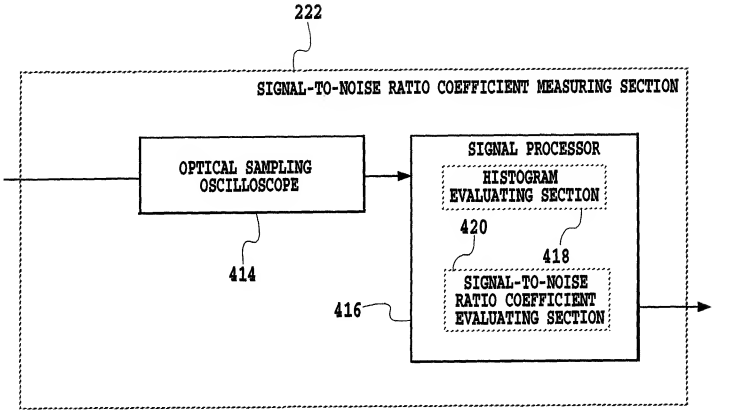

222
SIGNAL-TO-NOISE RATIO COEFFICIENT MEASURING SECTION
OPTICAL SAMPLING OSCILLOSCOPE
414
SIGNAL PROCESSOR
HISTOGRAM EVALUATING SECTION
420
418
SIGNAL-TO-NOISE RATIO COEFFICIENT EVALUATING SECTION
416

FIG.29

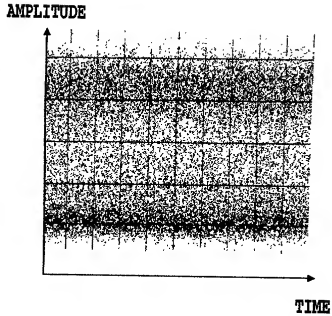


FIG.30A

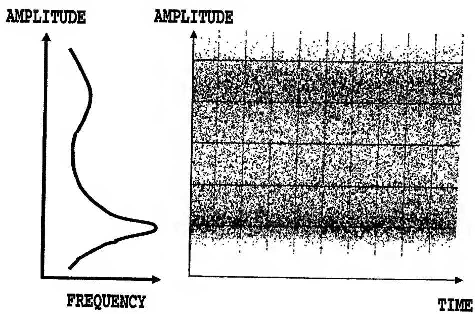


FIG.30B

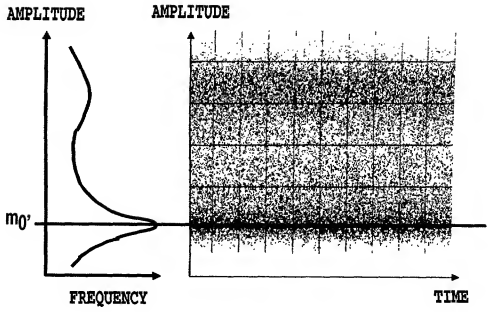


FIG.31A

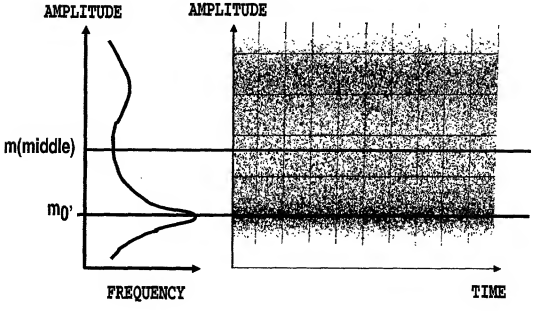


FIG.31B

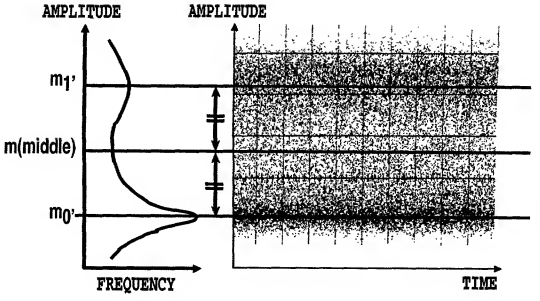


FIG.32A

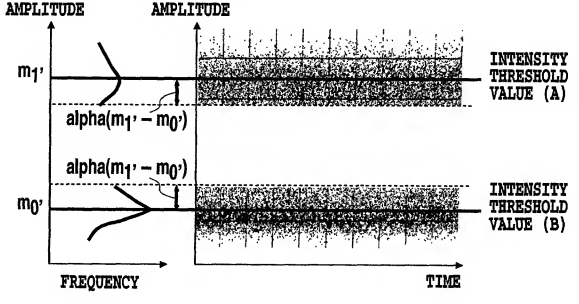


FIG.32B

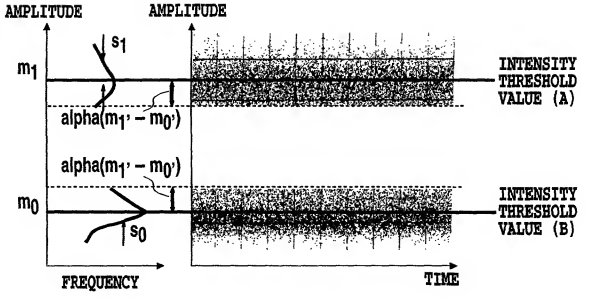
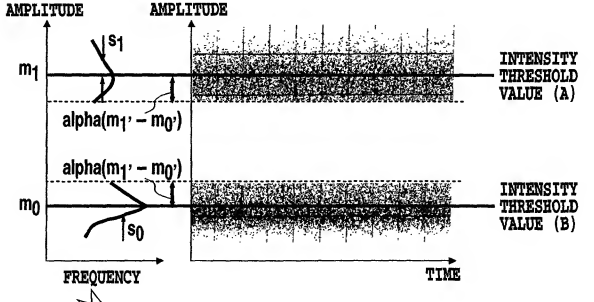


FIG.33A



$$Q = | m_1 - m_0 | / (s1 + s0)$$

FIG.33B

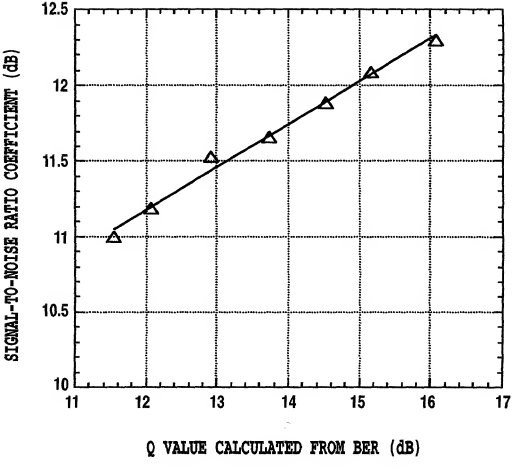


FIG.34

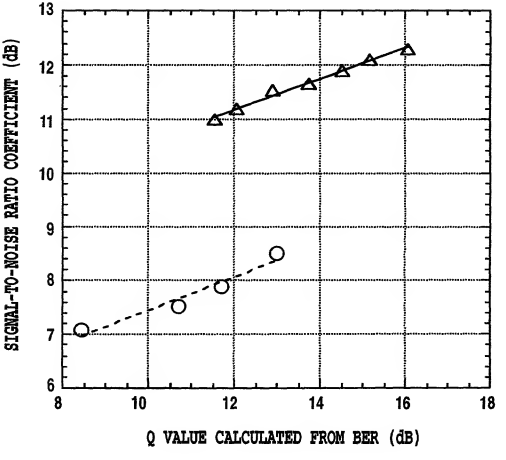


FIG.35

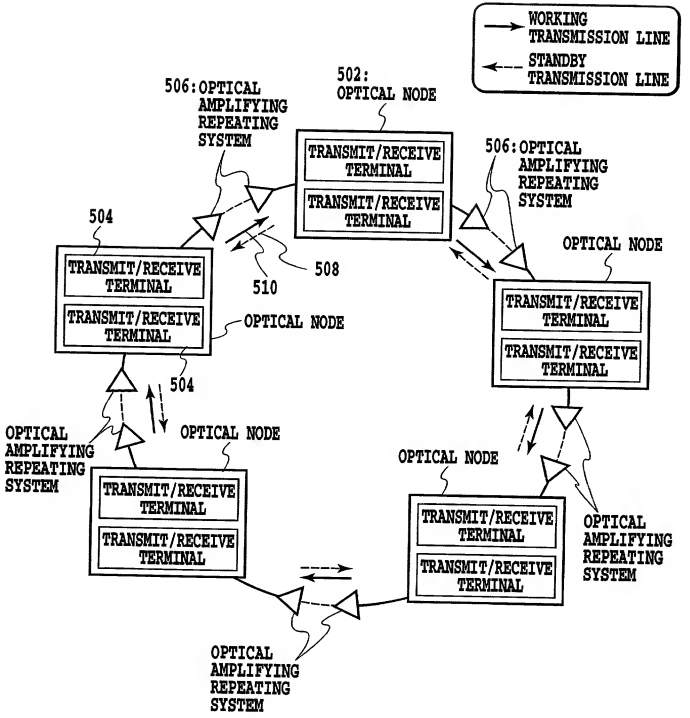

WORKING TRANSMISSION LINE
STANDBY TRANSMISSION LINE
506: OPTICAL AMPLIFYING REPEATING SYSTEM
502: OPTICAL NODE
TRANSMIT/RECEIVE TERMINAL
TRANSMIT/RECEIVE TERMINAL
506: OPTICAL AMPLIFYING REPEATING SYSTEM
504
508
510
OPTICAL NODE
TRANSMIT/RECEIVE TERMINAL
TRANSMIT/RECEIVE TERMINAL
OPTICAL NODE
504
OPTICAL AMPLIFYING REPEATING SYSTEM
OPTICAL NODE
TRANSMIT/RECEIVE TERMINAL
TRANSMIT/RECEIVE TERMINAL
OPTICAL NODE
TRANSMIT/RECEIVE TERMINAL
TRANSMIT/RECEIVE TERMINAL
OPTICAL AMPLIFYING REPEATING SYSTEM
OPTICAL AMPLIFYING REPEATING SYSTEM

FIG.36A

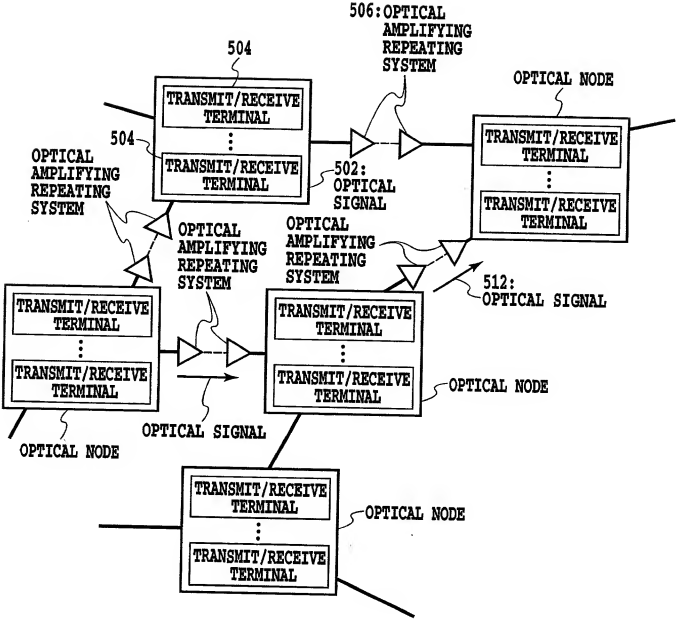

506:OPTICAL AMPLIFYING REPEATING SYSTEM
504
OPTICAL NODE
TRANSMIT/RECEIVE TERMINAL
TRANSMIT/RECEIVE TERMINAL
504
OPTICAL AMPLIFYING REPEATING SYSTEM
502: OPTICAL SIGNAL
OPTICAL AMPLIFYING REPEATING SYSTEM
OPTICAL AMPLIFYING REPEATING SYSTEM
OPTICAL AMPLIFYING REPEATING SYSTEM
512: OPTICAL SIGNAL
OPTICAL NODE
OPTICAL SIGNAL
OPTICAL NODE
OPTICAL NODE

FIG.36B

FIG.37

FIG.37A FIG.37B

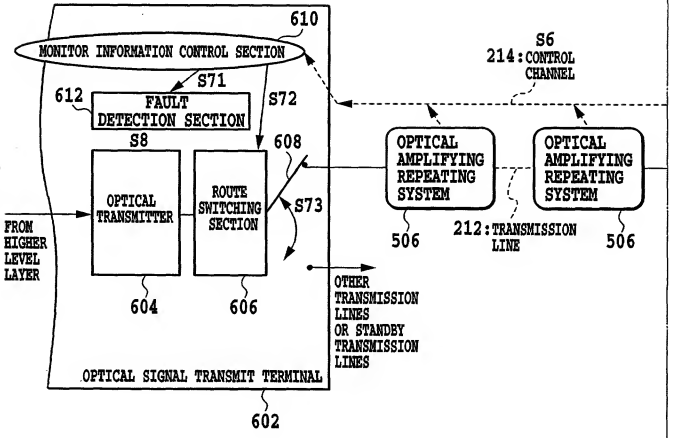


FIG.37A

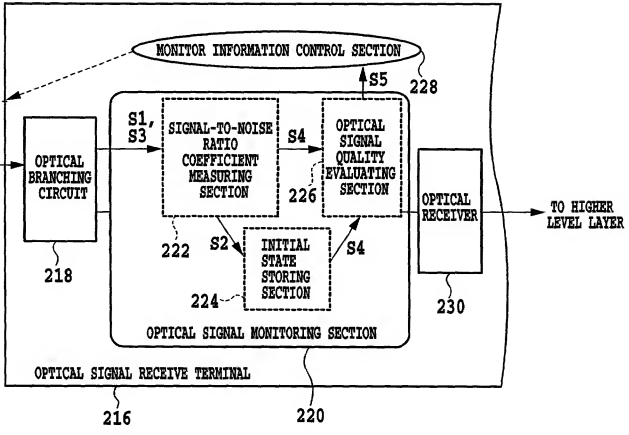

MONITOR INFORMATION CONTROL SECTION
S5
228
S1,
S3
SIGNAL-TO-NOISE RATIO COEFFICIENT MEASURING SECTION
S4
OPTICAL SIGNAL QUALITY EVALUATING SECTION
226
OPTICAL BRANCHING CIRCUIT
218
222
S2
INITIAL STATE STORING SECTION
S4
224
OPTICAL RECEIVER
230
TO HIGHER LEVEL LAYER
OPTICAL SIGNAL MONITORING SECTION
OPTICAL SIGNAL RECEIVE TERMINAL
216
220

FIG.37B

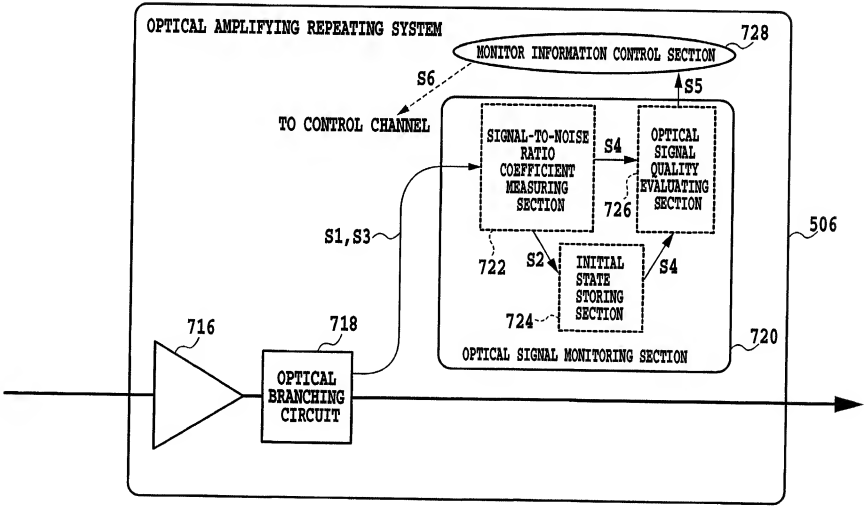

OPTICAL AMPLIFYING REPEATING SYSTEM
MONITOR INFORMATION CONTROL SECTION
728
S6
S5
TO CONTROL CHANNEL
SIGNAL-TO-NOISE RATIO COEFFICIENT MEASURING SECTION
S4
OPTICAL SIGNAL QUALITY EVALUATING SECTION
726
S1,S3
506
722
S2
INITIAL STATE STORING SECTION
S4
724
716
718
OPTICAL BRANCHING CIRCUIT
OPTICAL SIGNAL MONITORING SECTION
720

FIG.38

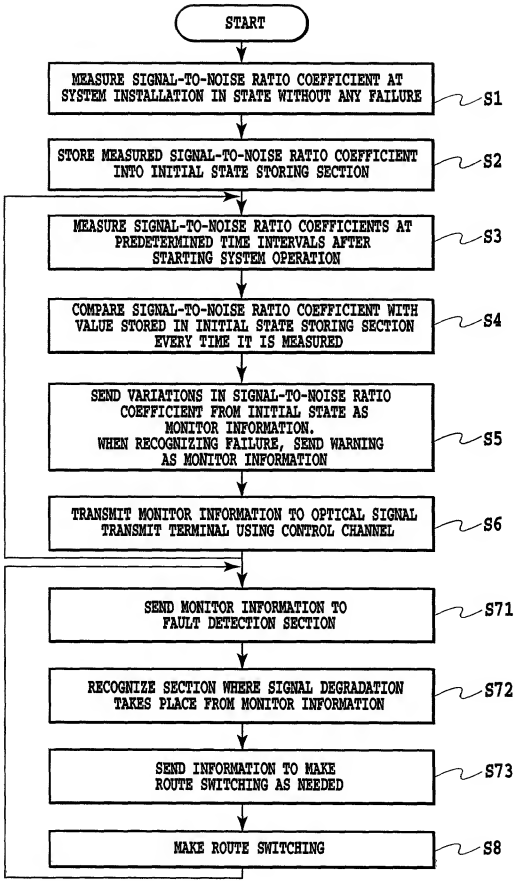

START
MEASURE SIGNAL-TO-NOISE RATIO COEFFICIENT AT SYSTEM INSTALLATION IN STATE WITHOUT ANY FAILURE
S1
STORE MEASURED SIGNAL-TO-NOISE RATIO COEFFICIENT INTO INITIAL STATE STORING SECTION
S2
MEASURE SIGNAL-TO-NOISE RATIO COEFFICIENTS AT PREDETERMINED TIME INTERVALS AFTER STARTING SYSTEM OPERATION
S3
COMPARE SIGNAL-TO-NOISE RATIO COEFFICIENT WITH VALUE STORED IN INITIAL STATE STORING SECTION EVERY TIME IT IS MEASURED
S4
SEND VARIATIONS IN SIGNAL-TO-NOISE RATIO COEFFICIENT FROM INITIAL STATE AS MONITOR INFORMATION. WHEN RECOGNIZING FAILURE, SEND WARNING AS MONITOR INFORMATION
S5
TRANSMIT MONITOR INFORMATION TO OPTICAL SIGNAL TRANSMIT TERMINAL USING CONTROL CHANNEL
S6
SEND MONITOR INFORMATION TO FAULT DETECTION SECTION
S71
RECOGNIZE SECTION WHERE SIGNAL DEGRADATION TAKES PLACE FROM MONITOR INFORMATION
S72
SEND INFORMATION TO MAKE ROUTE SWITCHING AS NEEDED
S73
MAKE ROUTE SWITCHING
S8

FIG.39

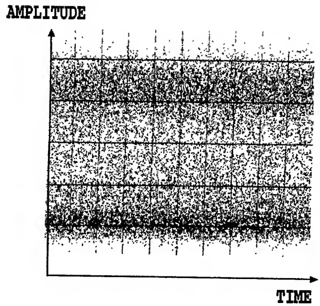


FIG.40A

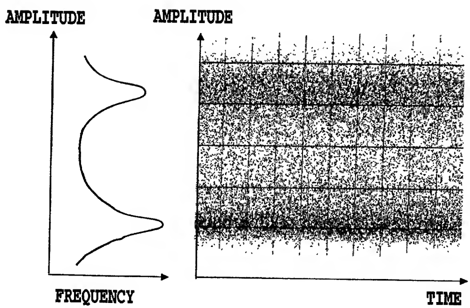


FIG.40B

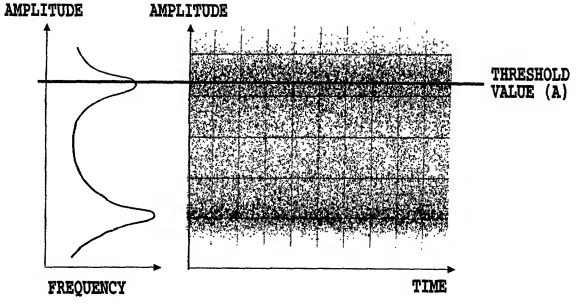


FIG.41A

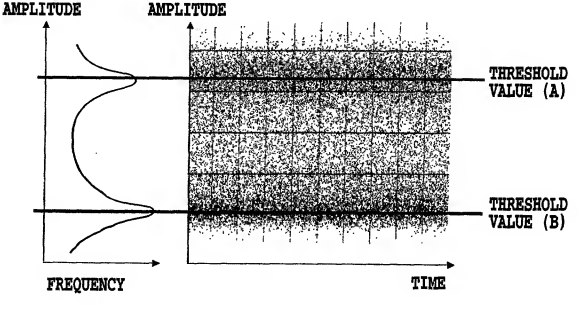


FIG.41B

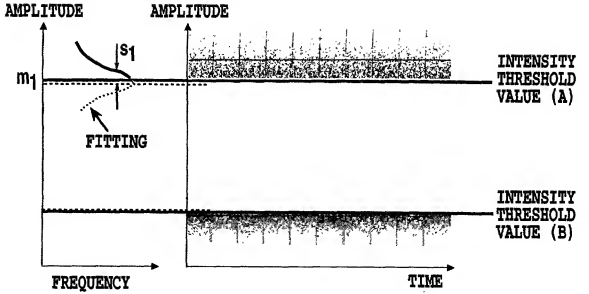


FIG.42A

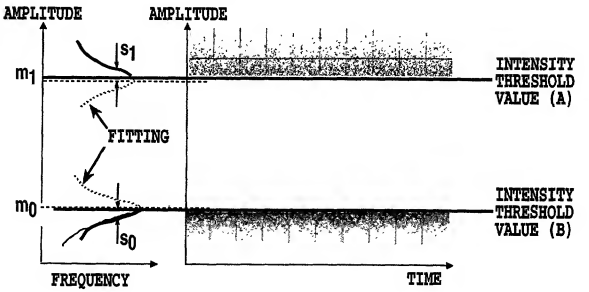


FIG.42B

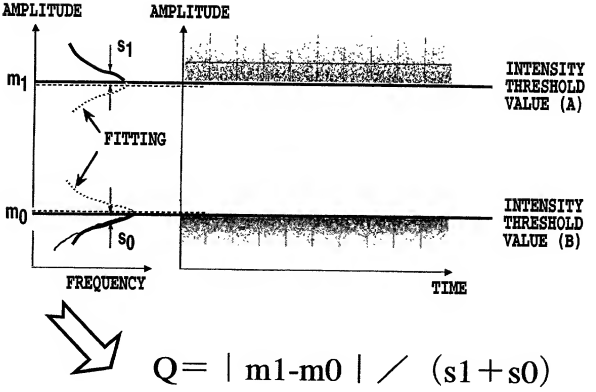


FIG.43

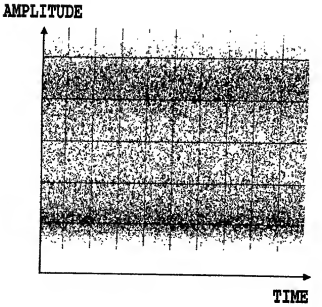


FIG.44A

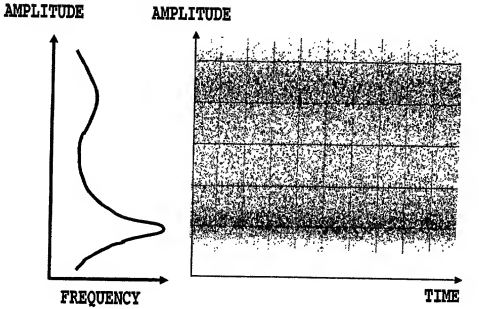


FIG.44B

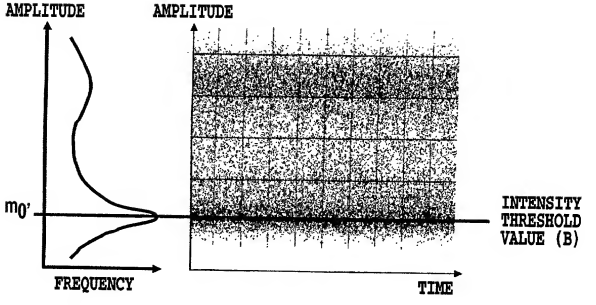


FIG.45A

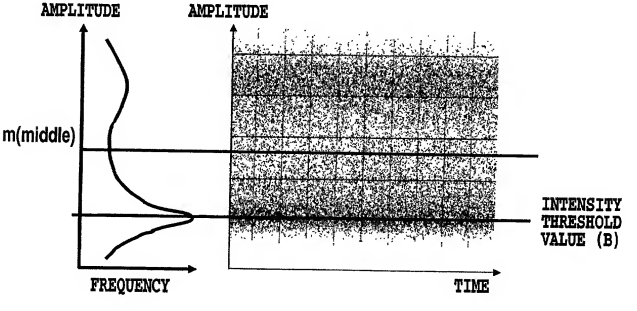


FIG.45B

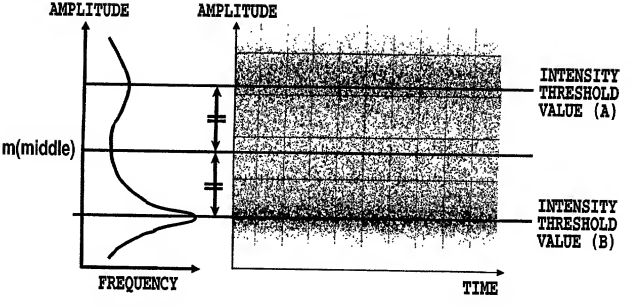


FIG.46A

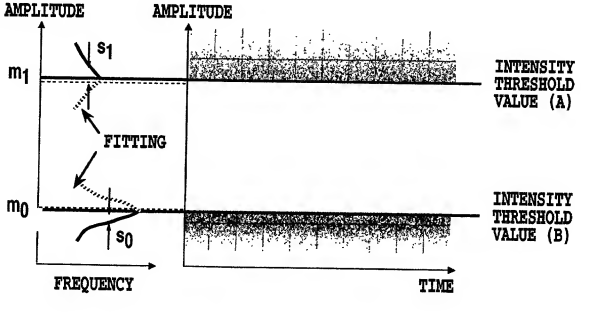
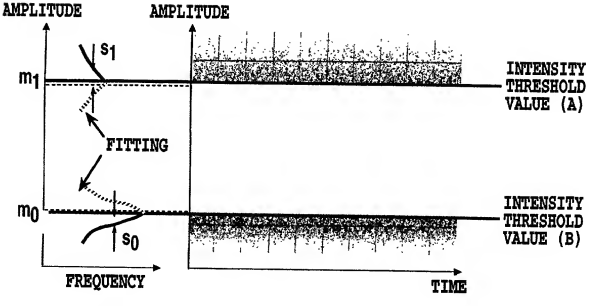


FIG.46B



$$Q = | m1-m0 | / (s1+s0)$$

FIG.47

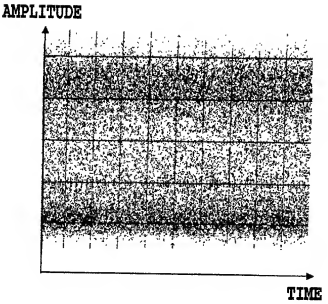


FIG.48A

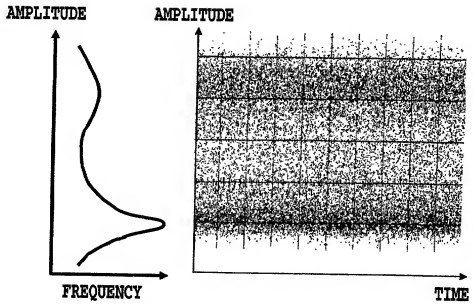


FIG.48B

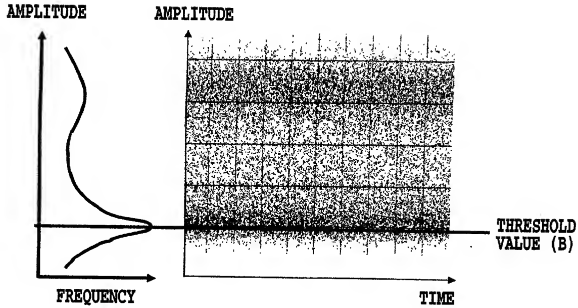


FIG.49A

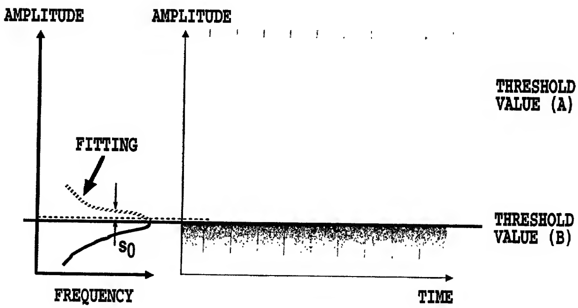


FIG.49B

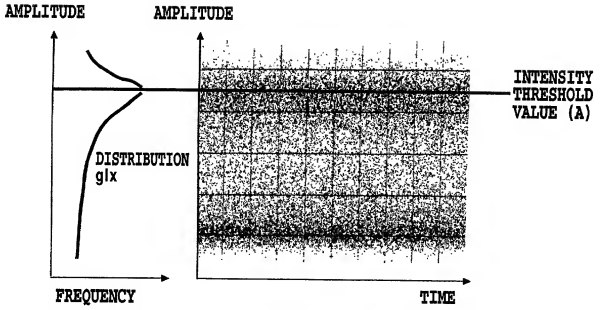


FIG.50A

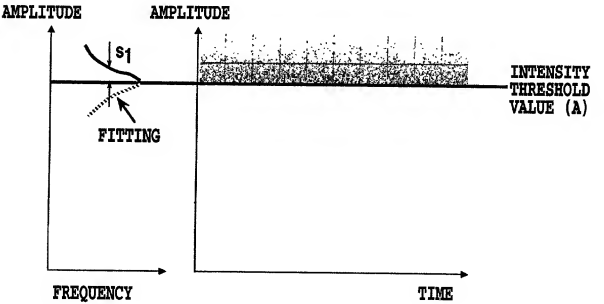


FIG.50B

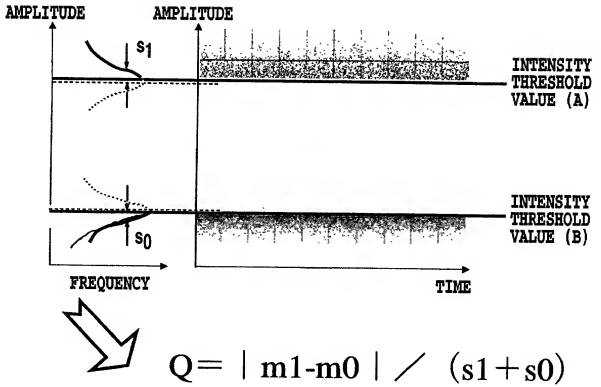


FIG.51

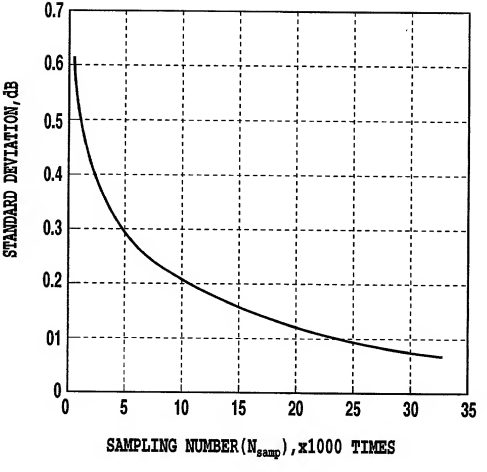

STANDARD DEVIATION, dB
0.7
0.6
0.5
0.4
0.3
0.2
01
0
0
5
10
15
20
25
30
35
SAMPLING NUMBER(N_{samp}), x1000 TIMES

FIG.52

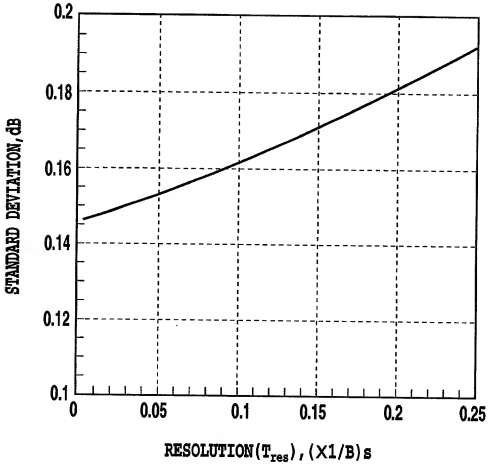


FIG.53A

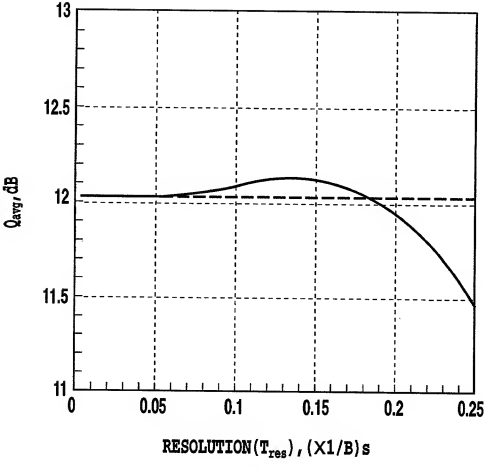

13
12.5
12
11.5
11
Q_{avg}, dB
0
0.05
0.1
0.15
0.2
0.25
RESOLUTION(T_{res}), (X1/B)s

FIG.53B

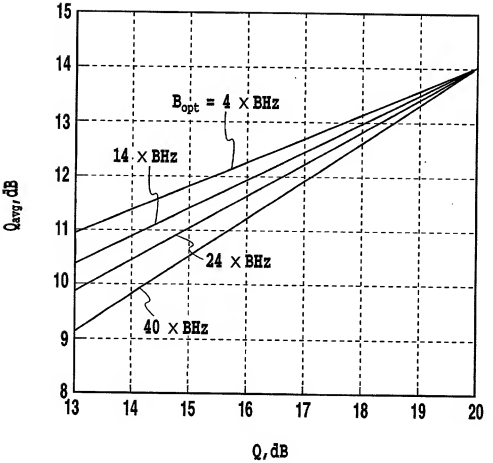


FIG.54A

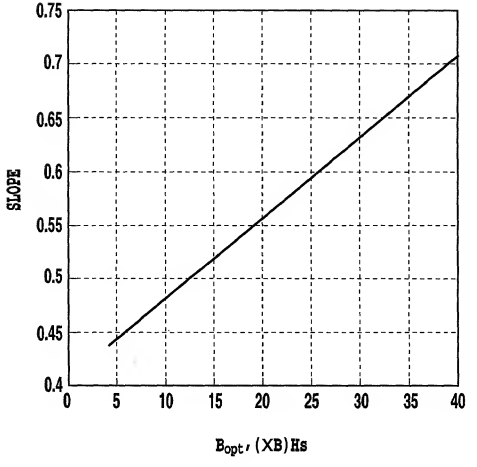


FIG.54B